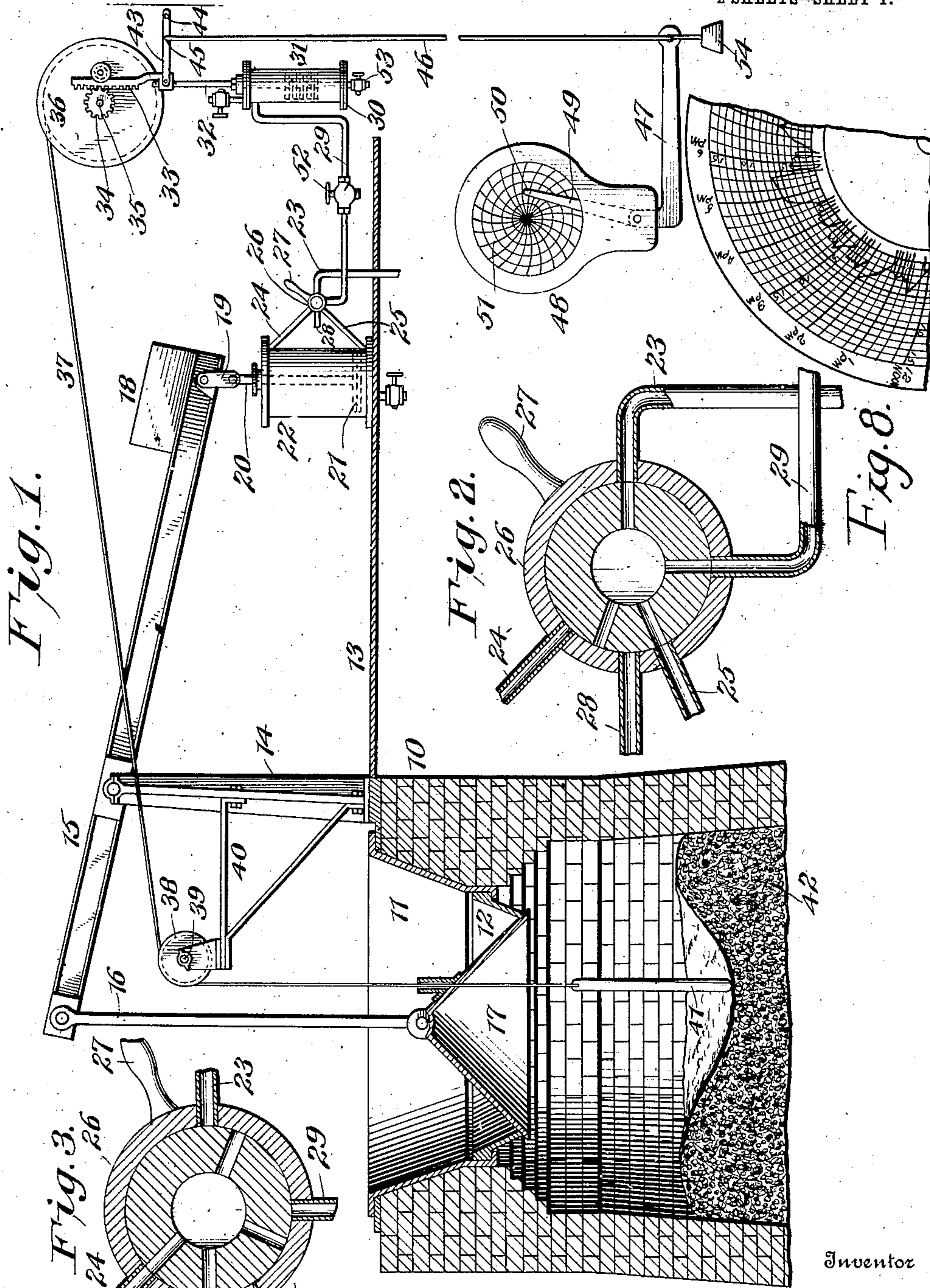


APPLICATION FILED MAY 3, 1906.

951,128.

Patented Mar. 8, 1910.

2 SHEETS—SHEET 1.



Witnesses
Herman Meyer
Alan McDonald.

By *J. E. Johnson, Jr.*
William R. Baird
his Attorney

J. E. JOHNSON, JR.
STOCK LINE RECORDER.
APPLICATION FILED MAY 3, 1906.

951,128.

Patented Mar. 8, 1910.

2 SHEETS—SHEET 2.

Fig. 5.

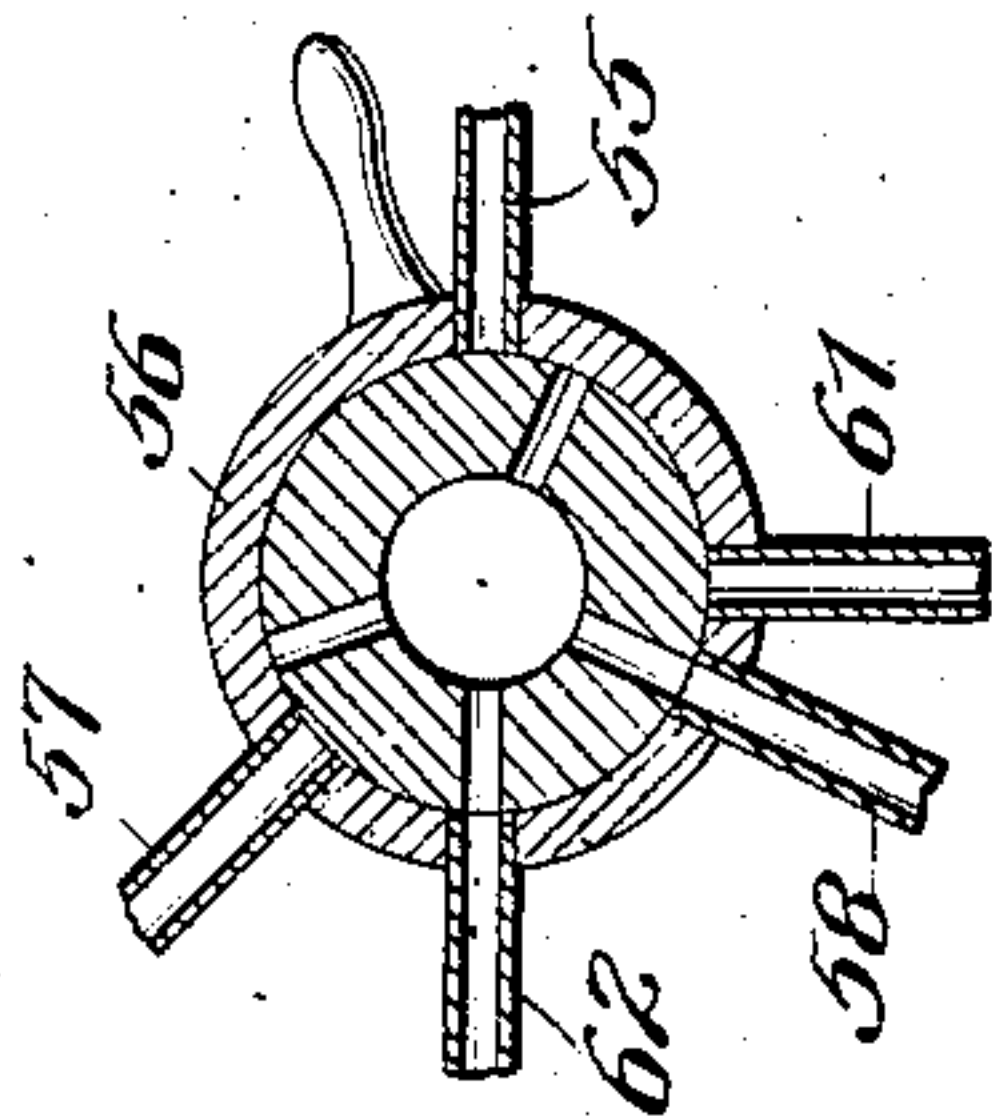


Fig. 7.

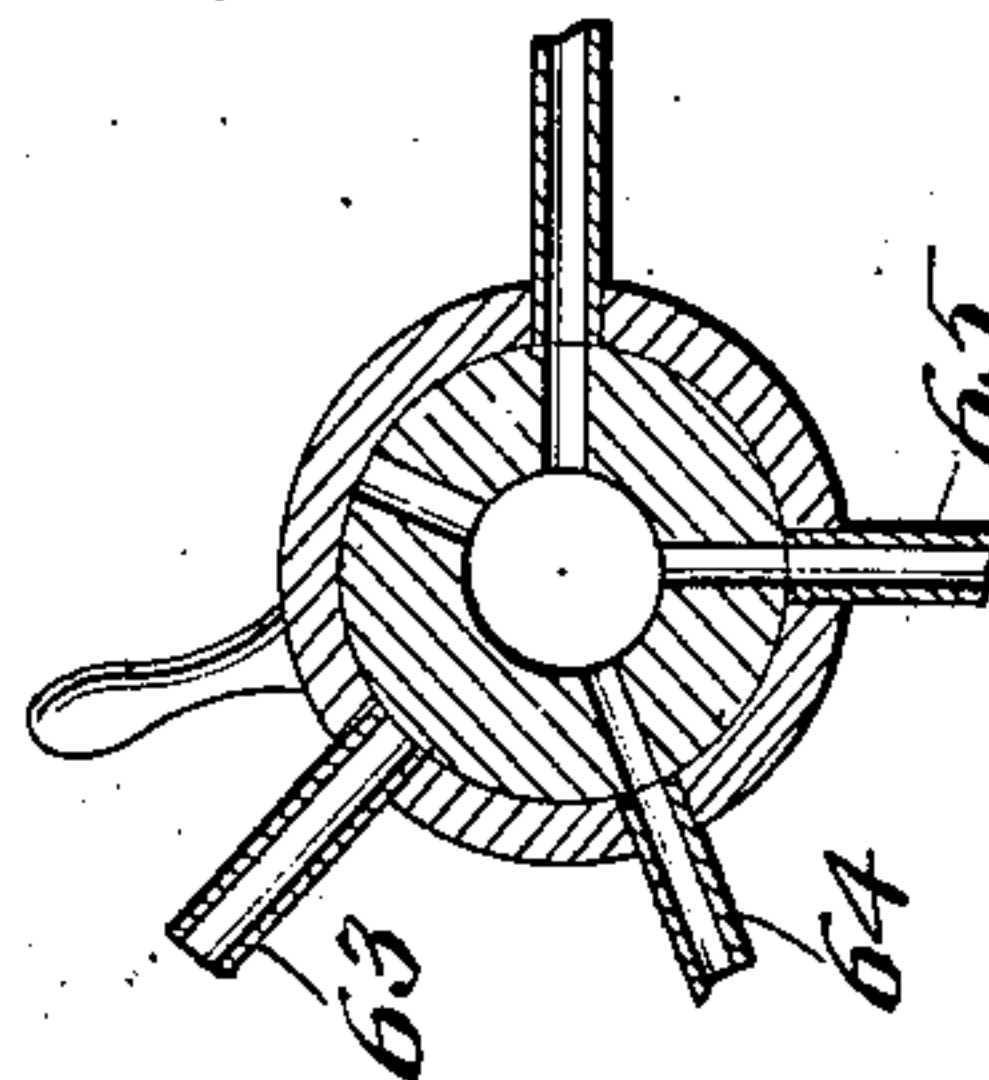


Fig. 4.

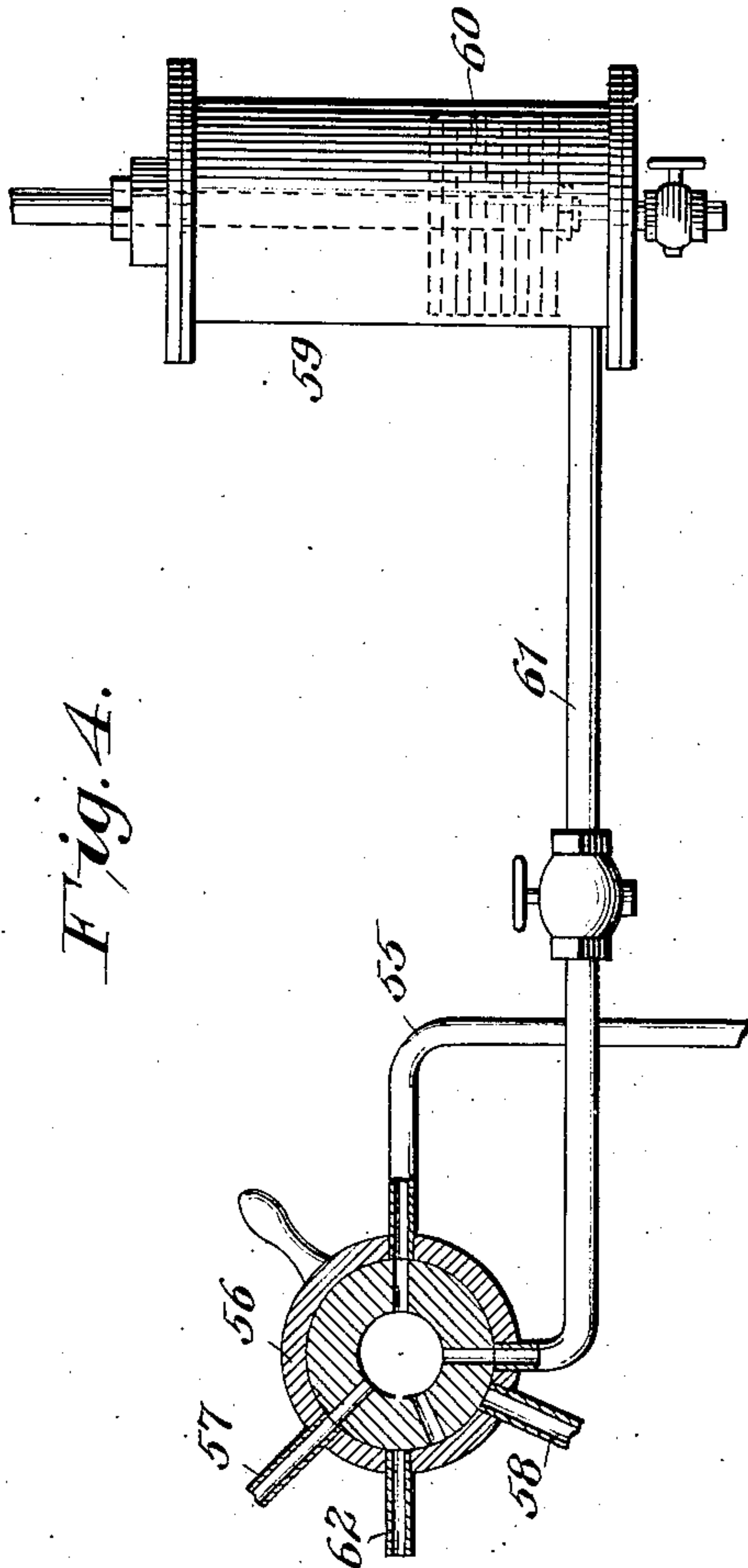
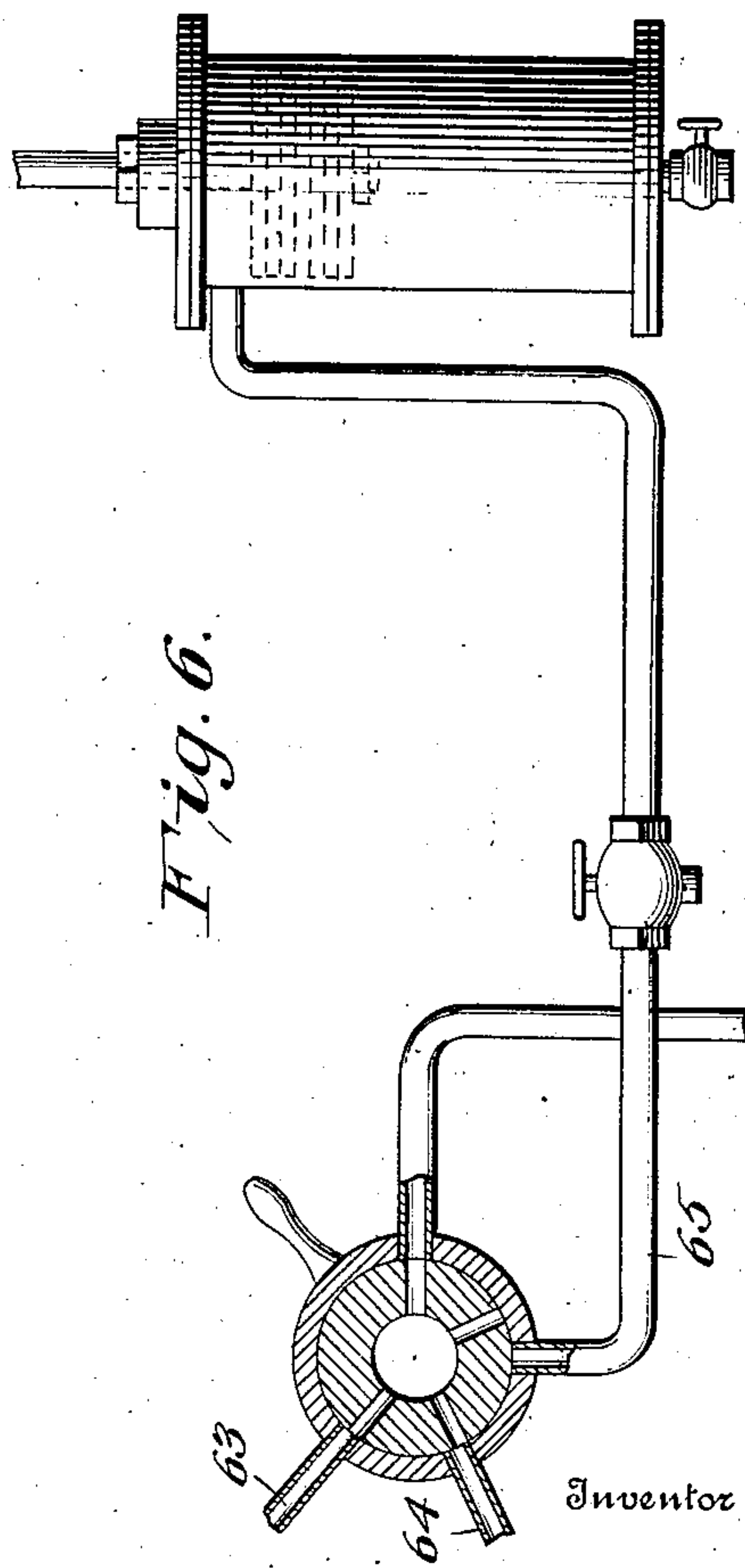


Fig. 6.



Witnesses
Herman Meyer
Alan Mc Donnell.

J. E. Johnson, Jr.
By William R. Baird
his Attorney

UNITED STATES PATENT OFFICE.

JOSEPH E. JOHNSON, JR., OF LONG DALE, VIRGINIA.

STOCK-LINE RECORDER.

951,128.

Specification of Letters Patent.

Patented Mar. 8, 1910.

Application filed May 3, 1906. Serial No. 315,074.

To all whom it may concern:

Be it known that I, JOSEPH E. JOHNSON, Jr., a citizen of the United States, residing at Long Dale, in the county of Alleghany and State of Virginia, have invented certain new and useful Improvements in Stock-Line Recorders, of which the following is a specification.

My invention relates to stock-line recorders for blast-furnaces, and has for its object the furnishing of a continuous record diagram of the height of the upper surface of the stock or material fed into the top of a blast-furnace or similar apparatus, recording the rate and nature of the descent of the stock at all times and the length of the time intervals occurring between successive charges.

It has long been customary to use a metal rod passing through a hole, or holes, in the hopper, or other place of access, to determine by hand-test from time to time the distance of the upper surface of the stock below the top of the furnace, and such rods have also recently been connected with graduated indicating means, whereby the position assumed at the time of testing could be more accurately read and measured for each observation. Furthermore, a means for recording the times of movement of the charging-bell of the furnace and the extent of movement thereof has been proposed from which might roughly be inferred the position of the stock-line at such times of opening; but under the modern conditions of blast-furnace operation, involving much higher pressure than formerly and much finer ores, something far more accurate and reliable than an occasional gaging of the stock-time or record of the times of dumping each charge of stock is required. The tendency of the stock to stick in the furnace and settle by jumps of greater or less magnitude at much varying intervals of time, is vastly increased, making it of great importance that the furnaceman should be forewarned of these conditions, and especially if the time interval since the stock last settled is of undue duration, so that he may take precautionary measures to prevent a "slip" of too great severity from which serious damage has frequently resulted. It is also very desirable to have a record, inaccessible to the "fillers," of the regularity with which the stock had been charged into the furnace, affording an in-

fallible check upon their operations. To supply such want is the object of the present invention.

The essential features of the present invention comprise; first a main bell upon which the stock, or material fed into the top of the blast furnace, rests until discharged therefrom by the lowering of the bell; second, automatic means, (such as a counterweight) for maintaining the bell in its raised or closed position; third a power cylinder (or other equivalent device) acting on the bell in the direction opposite to that of the closing means for lowering the bell to discharge the stock from the top of the bell into the furnace; next, a test rod, or rods, which rest upon the stock when the main bell is closed and indicate the positions and movements of its upper surface but which when the bell is opened are automatically withdrawn to be out of the way of the entering charge; and finally a cylinder (or equivalent device for exerting a moving force), connected by suitable mechanism to the test-rod or rods, whereby when the motive power is turned on, the test-rod is raised, and, when the motive power is turned off, the weight of the test-rod moves the piston of the cylinder, or its equivalent, in the opposite direction until the test-rod bottoms on the stock, and from that time until the motive power is turned on again, the test-rod descends with the stock, and moves the piston to its travel.

In the accompanying drawings, which illustrate an embodiment of my invention and some obvious modifications thereof, Figure 1 is a view partly in sectional and side elevation and partly diagrammatic, of my invention applied to a standard blast furnace. Fig. 2 is a detail sectional view of the controlling mechanism, on an enlarged scale. Fig. 3 is an enlarged sectional view of the test-rod and recorder cylinder controlling mechanism. Figs. 4 to 7 are sectional views illustrating modifications of the controlling mechanism. Fig. 8 represents a portion of a chart showing markings made by the operation of this invention.

Referring specifically to the drawings, 10 is the brickwork of the upper portion of an ordinary blast furnace, 11 is the hopper, 12, the hopper extension, 13, the filling platform: 14, a standard mounted on the brickwork of the furnace, 15, a lever fulcrumed

on the standard, 16, a rod or link depending from one end of the lever 15 and 17 the charging bell suspended from the lever 15 by the link 16 and resting under the inner edge of the hopper in its closed position. At the opposite end of the lever 15 is a counterweight 18, the size of which in connection with the relative length of the two ends of the lever 15, is sufficient to cause the bell 17 to remain normally in its upper or closed position.

Suspended on the lever 15 at the end which holds the counterweight 18, are links 19 loosely connecting a piston rod 20, with said lever, which piston rod carries a piston 21 fitted to move in a cylinder 22, as indicated in dotted lines in Fig. 1. The piston 21 and the rod 20, may be actuated in the cylinder 22 by any suitable fluid, such as steam, compressed air, gas, or any known equivalent thereof, which is supplied to the cylinder through a pipe 23 and branches 24 and 25 entering at the upper and lower ends, respectively. The supply is regulated or controlled by a suitable valve 26, having an operating handle 27. From this valve 26 projects an exhaust discharge pipe 28 and another pipe 29 leading to the upper end of a cylinder 30 in which is fitted a piston 31, carrying a piston-rod 32 which either carries at its upper end, or has its upper portion formed into, a rack 33 normally in engagement with a pinion 34 on a shaft 35. The shaft 35 also carries a drum, pulley, or sheave, 36 to which is secured one end of a chain 37 which leads therefrom over a guide pulley, or sheave, 38 mounted on a shaft 39 journaled in a bracket 40 supported on the standard 14 before mentioned. The chain 37 passes downward from the pulley 38 through the bell 17 to the inside of the furnace and carries at its lower end a test-rod 41 adapted to rest with its lower end upon the surface of the stock or material 42 in the furnace.

To the piston rod 32, at about the point of its junction with the rack 33, there is connected one end of the lever 43, pivoted at its outer end, at 44 and carrying at an intermediate point, as at 45, a wire 46 which is connected at its lower end, to the outer end of the lever 47 of a recorder 48. The lever 47 is of bell-crank form, its inner arm 49 carrying a pen or pencil at 50, which bears upon a graduated chart 51 supported on a part of the recorder which is actuated by clock-work contained therein.

The bell 17 is normally closed, or in its uppermost position, and is opened at intervals after a charge of stock has been dumped upon it, to permit this charge to drop into the furnace. When this takes place it is necessary that the test-rod be raised up out of the way so that it will not be buried under or injured by the falling stock. To

effect this simultaneous lowering of the bell and raising of the test-rod, steam, or other fluid, is passed into the lower end of the bell cylinder 22 and into the upper end of the test-rod or recorder cylinder and this operation is accomplished as follows: (see Figs. 1 to 3). The valve 26 is a four-way valve and by moving its operating handle it is so set that the operating fluid from the pipe 23 passes simultaneously through the pipe 25 into the lower end of the bell-cylinder 22, and through the pipe 29 into the upper end of the test-rod cylinder, 30, forcing the piston 21 up and with it the counterweight 18 thus causing the lowering of the other end of lever 15 and consequently, the lowering of the bell. During the passage of the power-fluid through the pipe 25, it also passes through the pipe 29, into the cylinder 30 above the piston 31 and forces it and its rod 32 downward and carries with it the rack 33. This causes the pinion 34 and shaft 35 to rotate, carrying around also the pulley or drum 36 and winding chain 37 thereon, whereby the test-rod is raised to its uppermost position in which it is above the line to which the stock is fed when the furnace is fully charged. As soon as the charge of stock is discharged into the furnace, the valve (by moving its handle) is adjusted into a position in which the pipe 24 is in communication with the exhaust pipe 28 through the proper ports and the fluid-power is cut off from both cylinders, so that the counterweight raises the bell into its closed position, while the test-rod, by its own weight, drops down until its lower end rests upon the surface of the stock in the furnace. The weight of the piston and rack is less than that of the test-rod but is sufficient to keep the chain taut so that the test-rod will always maintain a vertical position with its lower end resting on the surface of the stock in the furnace, simply following the stock down as it settles, unwinding the chain from the drum and raising the rack and piston. During this operation the pressure formerly admitted below piston 21, and above piston 31 is exhausted by any suitable means, such, for instance, as small pet-cocks. After this, the rod simply follows the stock down as it settles, unwinding the chain from the drum and raising the rack and piston. The piston 31 may be at any point above the bottom when the bell is open, depending upon the time of the last opening of the bell, and the rate of settlement of the stock, but the power-fluid always forces it to the bottom which raises the end of the test-rod above the highest level to which the stock is permitted to come, so that it shall never get caught by the stock. The amount of this over-travel is one or two feet. This also gives the mechanism some room for movement, no matter how full the furnace is, and

prevents the possibility of sticking which might occur if the piston simply went to the bottom and remained there when the furnace was full.

5 The travel of the rack and piston is seen to be directly proportional to that of the test-rod, though of less extent and this travel is still further reduced by the reducing lever 43 to such an amount that the
10 maximum vertical travel of the wire 46 will be the same as the total travel of the recorder lever 47 so that the maximum travel of the piston and test rod corresponds to the total travel of the recorder pen 50 and the
15 movement of the pen is proportional to the descent of the test-rod from its highest position. The recorder chart is divided into concentric circles and the pen is set on the zero circle when the furnace is full and the
20 one or two feet of over travel of the test-rod are shown beyond this line and do not count. If the stock in the furnace settles regularly, the motion of the chart, and of the pen, draws a diagonal or rather a spiral line on the chart. If the stock in the furnace stops
25 settling altogether, (called "sticking"), the pen simply draws a circle, and if the stock falls suddenly (known as "slipping"), the pen draws a plain transverse arc.

30 From the foregoing it will be observed that the valve which is the controlling device for the test-rod actuating mechanism, is also the controlling device of the actuating mechanism of the main bell of the furnace, whereby the greatest simplicity of
35 construction, ease of operation, and simultaneity of movement of the test-rod and main bell is attained.

40 In practice, it is preferable to use a cylinder for the test-rod somewhat larger than is necessary to obtain sufficient power to raise the test-rod when the full working pressure of the bell cylinder is used, and to throttle the supply pipe 29 by means of a suitable
45 valve as at 52, (Fig. 1), thus giving a reserve power which may be sometimes desirable.

50 I prefer to not quite close the bottom of the test rod cylinder so as to furnish an air cushion to avoid shock at the end of the piston movement, a small pet-cock 53 being provided to allow of the gradual escape of the compressed air of the cushion. A similar valve may be used for the same purpose
55 at the top of the same cylinder and at the bottom of cylinder 22.

60 The wire connecting the reducing lever with the recorder lever is kept taut by a weight 54 at its lower end so that the recorder lever is properly held in position for operation.

65 The mechanism hereinbefore described is perhaps the preferable form in which I have embodied my invention but many modifications thereof, or variations therefrom, may

be made without departing from the spirit and scope of the invention which involves the use of a motor or operating device actuated by any fluid or form of energy, as steam, compressed air, water, electricity, or mechanical power, to be controlled by such means as will cause it to raise the test-rod
70 connected to it by suitable mechanism at such times as the main bell opens and which will allow the test-rod to descend and rest upon the stock when the main bell closes, remain-
75 ing there and following the motion of the stock, so long as the main bell remains closed, with suitable mechanism for transmitting the motion of the test rod to a suitable re-
80 cording instrument on which the motion of the test rod shall be recorded on a reduced scale on a chart having a regular movement approximately at right angles to the move-
85 ment of the recorder pen or pencil. In Figs. 4 and 5 I have illustrated one of such modifications, in which the counterweight for the bell is omitted, and the fluid pressure normally admitted to the upper end of the bell cylinder to hold the bell closed.

90 Fig. 4 shows the parts in the normal position, in which the power fluid passes from the pipe 55 through the valve 56 and the pipes 57 and 61 respectively into the upper end of the bell cylinder and the lower end
95 of the test-rod or recorder cylinder, the pressure through the pipe 57 keeping the bell closed and that through the pipe 61 raising a weighted piston 60 and lowering the test-rod on the stock. When the fluid is cut off
100 from pipes 57 and 58 by adjusting the valve to the position of Fig. 5, the pipe 61 leading from the lower end of the bell cylinder is in communication, through suitable ports, with the exhaust outlet 62 and the fluid in the bell
105 cylinder below the piston is exhausted, permitting the bell to lower by its own weight and open itself. At the same time the weighted piston drops in the cylinder 59 and draws the test rod up out of the way of the
110 entering stock.

In the modification shown in Figs. 6 and 7 the counterweight is employed but part of the fluid pressure is admitted through the pipe 63 to the upper end of the bell cylinder
115 (Fig. 6) and part to the lower end through the pipe 64. When adjusted to the position of Fig. 7, the pressure is admitted to both cylinders as in Fig. 2, through the pipes 64 and 65, raising the piston in the bell cylinder and lowering the piston in the test-rod cylinder, as in the preferred construction shown in Figs. 1 and 2.

A number of test-rods may be used if properly connected to the counterweight
125 lever.

What I claim as new is—

1. A stock-line recorder for blast furnaces comprising a charging-bell normally closed, an actuating device for opening the
130

bell, a test-rod, an actuating device independent of the bell for raising test-rod when the bell is opened, and means for causing said actuating devices for both the bell
5 and test-rod to operate simultaneously.

2. A stock-line recorder for blast furnaces comprising a charging bell normally closed, a motor for opening the bell, a test-rod, a motor for raising the test rod, and a
10 single controlling device for both motors.

3. A stock-line recorder for blast furnaces comprising a charging-bell normally closed, a fluid cylinder for opening the bell, a test-rod, a fluid cylinder for raising the
15 test-rod, and a single valve for controlling the admission of fluid to both cylinders.

4. A stock line recorder for blast furnaces comprising a charging-bell, a counterweight for normally closing said bell, an
20 actuating device for raising the counterweight and opening the bell, a test-rod normally lowered, an actuating device for raising the test-rod independently of but simultaneously with the opening of the bell, and
25 a single controlling device for the actuating devices of both bell and test-rod.

5. A stock-line recorder for blast furnaces comprising a charging bell, a counterweight for normally closing said bell, a
30 motor raising the counterweight and opening the bell, a test-rod normally lowered, a motor for raising the test-rod simultaneously with the opening of the bell, and a single controlling device for the motors of
35 both the bell and test-rod.

6. A stock-line recorder for blast furnaces comprising a charging bell, a counterweight for normally closing said bell, a fluid
40 cylinder for raising the counterweight and opening the bell, a test rod normally lowered, a fluid cylinder for raising the test-rod simultaneously with the opening of the bell, and a single valve for controlling the fluid cylinders of both bell and test rod.

45 7. A stock-line recorder for blast furnaces comprising a lever, a charging-bell suspended at one end thereof, a counter-

weight at the other end of the lever, a fluid cylinder, a piston and piston rod therein, connections between the piston rod and the
50 counterweighted end of the lever, a shaft carrying a drum and a pinion, a second fluid cylinder, a piston and piston-rod therein, a rack carried by the piston-rod, a chain connecting the drum and test-rod, and a single
55 valve serving the two fluid cylinders controlling the supply of fluid to both cylinders.

8. A stock-line recorder for blast furnaces comprising a test-rod, a shaft carrying a pinion and a drum, connections between
60 the drum and the test-rod, a vertically reciprocating rack engaging the pinion, a recorder having a moving chart, a lever carrying a pen in contact with the chart, and connections between the rack or pinion and
65 the pen-lever of the recorder.

9. A stock-line recorder for blast furnaces comprising a test-rod, a shaft carrying a pinion and a drum, connections between
70 the drum and the test rod, a vertically reciprocating rack engaging the pinion, a clockwork having a moving chart, a lever carrying a pen in contact with the chart, a reducing lever connected with the rack or
75 pinion and a wire connecting the reducing lever and the lever of the recorder pen.

10. A stock line recorder for blast furnaces comprising a test-rod, a shaft carrying a pinion and a drum, connections between
80 the drum and the test-rod, a vertically reciprocating rack engaging the pinion, a clockwork having a moving chart, a lever carrying a pen in contact with the chart, a reducing lever connected with the pinion, a wire connecting the reducing lever and the
85 lever of the recorder pen and a weight at the end of the wire to keep it taut.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH E. JOHNSON, JR.

Witnesses:

H. FIRMSTONE,

F. F. MUSGROVE.